B&P File No. 13592-2

BERESKIN & PARR U.S. Application

Title: **System and Method for Viewing Micro-Markings on Jewelry and Other Objects**

Inventors: **Guerman Pasmanik**

Larissa Tiour

Field of the invention

This invention relates to jewelry and other objects such as bijouterie, keys, key chains and souvenirs, and more specifically relates to the viewing of markings therein.

Background of the invention

Engraving of jewelry is probably as old as jewelry itself. A typical engraving might include a date, a name or some sentimental message. The types of jewelry that have been traditionally engraved are varied, and include jewelry crafted from precious metals, such as gold, platinum and silver. The advent of lasers has increased the types of jewelry that can be engraved. For example, laser inscription can be performed on hard gemstones, such as diamonds.

Engraving can be divided into two categories: 1) macroscopic engraving, which can be read with the naked eye, and 2) microscopic engraving, which cannot be read with the naked eye, but which, instead, requires a loupe, or some other type of magnifying device to be legible. Laser diamond inscription can be done on the girdle of a diamond and is often microscopic, for example.

Both types of engraving have associated drawbacks. In macroscopic engraving, the larger size of the type required to make the inscription legible limits the amount of markings that can be included. In microscopic engraving, on the other hand, the inscription is smaller and therefore more markings can be included; however, the drawback is that a magnifying device, such as a loupe or microscope is required to read the inscription. Because carrying such a magnifying device, whenever the engraved jewelry is worn, is often not practical, microscopic engravings can only be read at selected locations having such devices.

Summary of the invention

To address the aforementioned drawbacks of engraved jewelry, the present invention teaches the use of a magnifying lens affixed to the piece of jewelry to view markings or information. Thus, the inscription can be made microscopic to store more information, and legible by viewing the inscription through the lens, which can be affixed to the piece of jewelry

In particular, described herein is a piece of jewelry comprising a medium that includes markings, and a lens positioned relative to the medium to allow the lens to magnify the markings for viewing. The medium can include transparent materials, such as plastics, glass or gemstones. The markings can appear on the surface of such media, or within such media, where appropriate.

In one embodiment the piece of jewelry includes a sufficiently transparent portion as the main constituent. For example, the piece of jewelry could be a cylindrically shaped glass earring, but having one end fashioned into a lens for viewing markings at another end. In this embodiment, the lens forms an integral part of the transparent portion and need not be affixed to the piece of jewelry with any affixing means.

In a different embodiment, the lens is affixed to the a part of the piece of jewelry using glue, clips, clamps or a cavity in which to insert the lens.

Also described herein is a method for viewing markings stored in a piece of jewelry. The method includes providing a lens in the piece of jewelry to allow the lens to magnify the markings for viewing.

The scope of the present invention includes a generalization of the above to include method or system for conveying information. The system includes an object containing markings for conveying information, the markings being of a size that make the markings difficult to discern with an unaided eye. The system further includes and a magnifying lens affixed to the object so that the markings are discernible when viewed with the magnifying lens, wherein the distance

between the lens and the markings remains substantially constant or wherein the lens can be translated with respect to the medium to position the lens in a proper position for viewing the markings. The objects can include jewelry, bijouterie, keys, key chains and souvenirs

Brief description of the drawings

Figure 1 shows a block diagram of a system for viewing markings stored in a piece of jewelry, according to the teachings of the present invention.

Figures 2A-C show one embodiment of the present invention in which the piece of jewelry of Figure 1 is a ring.

Figures 3A and 3B show other embodiments of the present invention in which the piece of jewelry of Figure 1 is a ring containing three lenses and three sets of markings, and one lens and two sets of markings.

Figure 4 shows a piece of jewelry that includes sufficiently transparent material fashioned at one end to form a lens, according to the principles of the present invention.

Figure 5 shows an earring as one example of the general embodiment exemplified in Figure 4.

Figure 6A shows a tube for viewing markings.

Figure 6B shows a tube for viewing markings from both sides of the tube.

Figures 6C and 6D show a pendant according to the teachings of the present invention.

Figure 6E shows a ring according to the teachings of the present invention.

Figures 7A and 7B show a plan and side view of a key in accordance with the principles of the present invention.

Figures 8A and 8B show a plan and side view of a pen cap in accordance with the principles of the present invention.

Figures 9A, 9B and 9C show key chains in accordance with the principles of the present invention.

Figure 10 shows the relative distances between the lens and medium, such as those shown in Figure 1, that are appropriate for a particular lens specification.

Figure 11 shows a tube for viewing markings having a lens translatable by screwing.

Detailed description of the invention

Figure 1 shows a block diagram of a system 10 for viewing markings stored in a piece of jewelry. The system 10 includes a piece of jewelry 12, a medium 14 affixed to the piece of jewelry 12, and a lens 16 disposed in the piece of jewelry 12. The system 10 may further include a recording device 18 and a protective cover 19.

As used herein, jewelry means an item that can be worn that has a significant ornamental and/or esthetic value. Thus, jewelry can include a brooch, a pendant, eyeglasses, a belt buckle, a ring, an earring, a locket, a bracelet, a key chain, a watch, a headband and a hair barrette.

The medium 14 is used for storing the markings, and the lens 16 is used for magnifying the markings to thereby make the pattern intelligible to a viewer. The recording device 18, such as a laser, can record the markings on the medium by, for example, laser inscription, as known to those of ordinary skill in the art. It should be understood that other methods of engraving are possible, such as engraving with an electron beam.

The markings can be covered with an optional protective cover 19 to protect the markings that are stored in the medium. Such a protective cover 19 can shield the markings to prevent scratches, dirt, mud, etc. In a preferred embodiment, the protective cover 19 is transparent to allow the markings to be viewed, and can be made from glass, for example. In a different embodiment, the protective cover 19 need not be transparent, but might instead include a hinged door that could be opened to expose the markings for viewing.

The word "markings" is used herein in a general sense and can include symbols, numbers and letters. The markings can include personal information, such as a name, a date of birth, an address, an emergency contact telephone, an emergency contact person, a health card number, a bank card number, a social security number, a pin number, a password, a username, a passport number, a clothes size and an anniversary date. The markings can also include medical information, such as a blood group type, a rhesus factor, an allergy, a disease

and a medication currently being taken by the wearer of the piece of jeweler. The markings can also include general information, such as a security phone number, an address, an aphorism, a poem, a formula and a portrait or other type of picture, such as may appear on a tattoo, for example. The markings need not be man-made. Thus, the markings may be a natural structure, such as a crack, spot, fracture or other imperfection on a gemstone, for example. The markings can be two or three-dimensional.

In one embodiment, the markings are formed with pixels and the dimension of the numbers, letters or symbols formed therefrom is about 1μm to 1mm, which would make the markings unintelligible with the naked eye. The lens 16 is used for magnification to make the markings intelligible to a viewer.

The medium in or on which the markings can be included includes substantially transparent materials such as gemstones, glass and plastics. In addition, the medium can include non-transparent materials. For example, the recording device 18 can inscribe a message on a gold ring, which message is too small to be easily viewed, or viewed at all with the naked eye. In this latter example, the medium is the surface of the gold ring. As described in more detail below, the inclusion of a magnifying lens 14 into the ring can permit a viewer to read the message. In this way, more markings can be inscribed on the ring since the text used can be smaller.

The recording device 18 can use one of several messages to produce the message on or in the medium. For example, as mentioned above, the recording device 18 can include a laser for engraving the markings on a surface of the medium.

The recording device 18 can also produce the markings in the interior of the medium. For example, in the case where the medium is diamond, methods are known for internally inscribing a message in the diamond. These methods include internal laser drilling and ion implantation, as known to those of ordinary skill.

For example, in internal laser drilling, an inscription can be placed on an internal fracture, which is itself surrounded by other small internal fractures. Colored lines extending along the length of these other small internal fractures in the same area have black lines extending along their length can be produced to help write the inscription.

In a second example, in ion implantation, also known as doping, energetic ions are introduced into a solid. By bombarding a diamond, for example, with

either argon or boron atoms, one can create "marks" inside the stone. The marks are actually slight deformations in the crystal lattice that scatter light, and thus they tend to show up as thin white lines. In this method, the depth of the inscription can be made uniform, and can be suspended a uniform distance below the surface (a few tenths of a millimeter). This can be achieved by controlling the energy of a beam of ions of a particular size.

The lens 16 is a magnifying lens to enlarge the markings for viewing. As known to those of ordinary skill, such a lens can be obtained with the use of a converging lens where the focal length, *f*, of the lens is greater than the distance, *s*, of the lens to the markings. Such a lens produces an erect, enlarged and virtual image of the markings. Another example of lens 16 that can be used in the present invention is a converging lens where $f > s$, which yields an inverted, enlarged and real image of the markings.

In some embodiments, the distance between the lens and the markings remains substantially fixed; in other words, during the normal, useable life of the piece of jewelry, the distance between the center of the lens and the markings does not change substantially. (It is contemplated that in some embodiments the lens and/or the medium containing the markings might move slightly, as might occur if the lens 16 and/or medium 14 jiggle in the lens cavity 34 or the medium cavity, respectively. It is also contemplated that the lens and/or medium might

rotate about the dashed vertical axis shown; in such case, the center of the lens and the markings would not change substantially.) Advantageously, having this distance remain substantially constant obviates the need to manually, or otherwise, position the lens to obtain proper magnification. In addition to this convenience, by not including mechanisms that would be required to effect a change in this distance, the integrity of the piece of jewelry is more easily maintained. Time consuming and/or expensive repairs that might have to otherwise be performed on such mechanisms are avoided.

The lens 16 is affixed to the rest of the piece of jewelry in such a manner as to allow the lens to remain affixed to the rest of the piece of jewelry while the latter is worn. In a preferred embodiment, the lens remains affixed to the rest of the piece of jewelry during the normal, useable life of the piece of jewelry, removals for repair and other "abnormal periods" notwithstanding.

Figures 2A-C show one embodiment of the present invention in which the piece of jewelry of Figure 1 is a ring 30. In particular, Figure 2A shows a cross sectional view of the ring 30, Figure 2B shows an angled view of the ring 30 and Figure 2C shows a side view of the ring 30. The ring 30 includes the medium 14 and the lens 16.

In the illustrated embodiment, the medium 14 is a glass material on which is inscribed markings 17, viz., a name, date of birth and blood type. The inscription 17 can be produced with a recording device 18, such as a laser. The ring includes a medium cavity 32, in which the medium 14 is disposed, and a lens cavity 34, in which the lens 16 is disposed.

Several methods exist to affix the medium 14 and the lens 16 to the piece of jewelry 12. These methods include gluing with a paste or glue (for example, adhesive glue), welding, drilling of cavities and preparing slots for the lens, which can then be fastened with prongs.

The lens 16 is disposed opposite the medium 14. A viewer can look through the lens 16 and see the markings in magnification. Conveniently, there is no need to separately carry loupes, or other magnifying devices, to view the markings.

Figures 3A and 3B show embodiments of the present invention in which the piece of jewelry 12 of Figure 1 is a ring containing three lenses and three sets of markings, and one lens and two sets of markings. In particular, Figure 3A shows a ring 39 containing a plurality of lenses 40, 42 and 44. Opposite each of the lenses 40, 42 and 44 is a corresponding medium 46, 48 and 50 containing

markings. For example, markings inscribed in medium 46 can be viewed with the lens 40. The magnification power of each lens 40, 42 and 44 can be different depending, for example, on the size of the markings in each of the lenses 40, 42 and 44. In addition, for esthetic effect, the lenses 40, 42 and 44 and the media 46, 48 and 50 can be of various colors.

Figure 3B shows a ring 51 that includes one lens 53 and a first medium 55 and a second medium 57, which can contain one set of markings each. Such an embodiment is feasible when both media 55 and 57 are substantially opposite the lens 53, so that one lens 53 is sufficient for proper magnification of both sets of markings.

Figure 4 shows a piece of jewelry 60 that includes sufficiently transparent material 62 fashioned at one end to form a lens 64. The substantially transparent material 62 includes markings 66 provided opposite the lens 64.

The lens 64 magnifies the markings 66 to thereby make the markings 66 intelligible to a viewer. Since the lens 64 is formed from a sufficiently transparent portion of the piece of jewelry, the portion should have the requisite shape to serve as the lens 64. For example, in the illustrated embodiment, the piece of jewelry includes a spherical portion with one end of the sphere cut off, and at

whose face the markings 66 can be inscribed. Moreover, the portion should be sufficiently transparent to allow the markings 66 to be read.

As described above, the markings 66 can include various patterns, such as letters, numbers, and pictures. The markings 66 can be inscribed on the surface or within the piece of jewelry.

Figure 5 shows an earring 70 as one example of the general embodiment exemplified in Figure 4. The earring 70 is largely cylindrical, but has a domed part 72 at one end 74. An inscription 71 can be engraved on the flat face of the other end 76. An optional protective cover 73 can cover the inscription 71 for protection from scratching, etc.

Figure 6A shows a tube 82 according to the teachings of the present invention. The tube 82 has a central body 83, a lens 84 at one end 86 and a medium 88 on which to inscribe at another end 90. An inscription (not shown) can be engraved on a flat face of the medium 88 at the other end 90. In one embodiment, the medium 88 can be substantially transparent to aid in viewing the inscription. The core of the body 83 can be hollow. Alternatively, the core can be constructed from a substantially transparent material.

In one embodiment, the lens 84, the body 83 and the material 88 at the end 90 can all be one solid piece. In particular, as described above with reference to Figure 4, the tube 82 can be formed from a single, transparent solid fashioned at one end 86 into a lens 84, and inscribed at the other end 90 with a message. Alternatively, the lens 84, the body 83 and the medium 88, which is inscribed with a message at the other end 90, can be separate pieces that are connected together, by gluing, welding, drilling, fastening with prongs, and other connecting methods known to those of ordinary skill in the art. The connecting methods used can permanently connect the lens, the body and the medium. Alternatively, the methods used can connect the pieces so that separating them would be difficult. In such case, separation might need to be performed by a technician using special tools, on occasions where the tube 82 is repaired, or the inscription is changed, for example. In yet another embodiment, the lens, the body 83 and the medium 88 can be connected so as to allow for easy disassembling.

Figure 6B shows a tube 200 for viewing markings from both sides of the tube 200. The tube 200 has a central body 202, a first lens medium 204 at one end 206 and a second lens medium 208 at another end 210.

The first lens medium 204 functions as both a lens and a medium on which to include a first set of markings, such as an inscription. Similarly, the second lens medium 208 functions as both a lens and a medium on which to include a second set of markings. In particular, a person can read the second set of markings on the second lens medium 208 by viewing the markings through the first lens medium 204. Similarly, a person can read the first set of markings on the first lens medium 204 by viewing the markings through the second lens medium 208. In this embodiment of the tube 200, the lens media 204 and 208 should be sufficiently transparent so as to allow viewing therethrough. The core of the body 202 can be hollow. Alternatively, the core can be constructed from a substantially transparent material.

Figures 6C and 6D show a front view and a side view of a pendant 80. In this example, the pendant 80 includes the tube 82 containing the lens 84 at one end 86 and the medium 88 at another end 90, which medium can be transparent. (Instead of the tube 82, the tube 200 can be used, where appropriate.) An inscription (not shown) can be engraved on a flat face of the transparent material 88 at the other end 90. In this example, when the pendant 80 is worn by a first person, the tube 82 is not visible to a second person from the front, and perhaps partially visible from the side. The tube 82 can be removably or permanently affixed to the rest of the pendant 80.

Instead of a pendant, other types of jewelry, such as a watch, belt or eyeglasses, can be so constructed. In addition, key chains and key rings can also be provided with a cylindrical (or other appropriate shape), sufficiently transparent material. For example, Figure 6E shows a ring 92 having the tube 82 (the tube 200 can instead be used) described above.

It should be understood that various modifications could be made to the embodiments described and illustrated herein, without departing from the present invention. For example, although examples have been presented involving rings and earrings, various other types of jewelry, such as pendants, necklaces, bracelets, brooches, belt buckles, souvenirs and pens, can be produced according to the principles of the present invention. In addition, other objects besides jewelry can be produced according to the principles of the present invention. Thus, any object can be used to convey information contained therein. In particular, markings can be included in the object, such as by engraving, stamping, etching, printing, writing, molding, casting, carving or otherwise marking the object. The markings are of a size that makes the markings difficult to discern with the unaided eye. Because of the small size, more information can be included. A magnifying lens is affixed to the object, such as in one of the ways described above, so that the markings are discernible when viewed with the magnifying lens.

For example, Figures 7A and 7B show a plan and side view of a key 94 in accordance with the principles of the present invention. The key 94 includes a magnifying lens 96 and a medium 98 containing markings. Looking through the lens 96 reveals the markings in magnification.

Figures 8A and 8B show a plan and side view of a pen cap 102 in accordance with the principles of the present invention. The pen cap 102 includes a magnifying lens 104 and a medium 106 containing markings. Looking through the lens 104 reveals the markings in magnification.

Figures 9A-9C show various types of key rings 107 to which are attached tubes as described above with reference to Figure 6A. In Figure 9A, the tube is inserted into an ornamental pyramidal shape 108. In Figure 6C, the tube is attached to an ornamental ring 109. In Figure 9C, the tube is attached directly to the key ring 107.

Referring to Figure 10, the geometry of the lens 110 and medium 112 containing the markings 114 is now described. In this example, the markings 114 consist of a circle and an "x" connected by a line. The appropriate distance between lens 110 and the markings 114 is furnished by the lens maker's formula:

$$1/a + 1/b = 1/f,$$

where a,b,*f* are provided in Figure 9. The magnification coefficient, *k*, is given by

$$k=f/(f\text{-}a)$$

$$=f+b/f$$

and depends on f. For the best resolution in practice, $|b|=b_0=25$ cm. Therefore, according to the lens maker's formula, the distance between the lens 110 and the markings is given by:

$$a= b_0/f+ b_0.$$

For example, if $f << b_0$, then the magnification constant is approximately given by $k= b_0/f$.

If a simple spherical lens is used, then the "non-aberrated" field of view (FOV) is determined as follows:

$$\theta=d/f=0.2,$$

where d is the diameter of the central area on the lens surface within which the aberrations are negligible. The maximum achievable number of pixels that comprise markings is

$$N=(\theta/\theta_d)^2,$$

where $\theta_d=\lambda/d$. $N=(f/25\lambda)^2$ decreases quadratically with decreasing f.

For example, for f=12 mm and λ=0.6 μm, N=800 x 800 pixels. To image one letter or one digit, approximately 10 x 10 pixels are required. The letter or number requires sufficient space along the horizontal and vertical directions. Moreover, and additional 10 x 10 + 10 x 20 pixels are required. Thus, in this example, 20 x 20 pixels should be reserved for one letter. For f=12 mm, a

maximum of 40 x 40 letters or digits can be included in the medium for magnification---for f =24 mm, N=80 x 80 letters, and for f =6 mm, N=20 x 20 letters.

In some embodiments, the distance between the lens and the markings is less than or equal to 30mm.

In some embodiments, the lens may be placed into proper position for viewing the markings by one or more translations of the lens relative to the medium. For example, Figure 11 shows a tube-shaped system 133, similar to the tube 82 shown in Figure 6A, having the lens 122 and a male screw assembly 134 coupled thereto. When the lens 122 is screwed into a female threaded portion 136, the lens 122 translates relative to the markings on the medium 124, thereby changing the distance therebetween. The screw assembly 134 should be hollow or sufficiently transparent to allow the markings on the medium 124 to be visible when viewed through the lens 122. Of course, the female portion could instead be attached to the lens 122 and the male portion could be attached to the medium 124 containing the markings.

Allowing the distance between the lens and the markings to vary by the above described translations permits persons of varying vision acuity (e.g., nearsighted or farsighted persons) to adjust this distance for appropriate viewing.

It should be understood that variations of the embodiments described above can be contemplated. The scope of the present invention is defined by the appended claims.